

- 1 1. A system for determining a level of a substance, the system comprising:
2 a first conductive element conveying a first electromagnetic signal in proximity to a
3 plurality of substances;
4 a coupler positioned at a dielectric mismatch boundary between the substances, the
5 coupler causing a change in a capacitance of the first conductive element upon the first
6 electromagnetic signal traversing a part of the first conductive element substantially adjacent to
7 the coupler;
8 a second conductive element conveying a second electromagnetic signal based on the
9 first electromagnetic signal and being coupled thereto by the change in capacitance of the first
10 conductive element caused by the coupler; and
11 a processor executing instructions to determine a level of at least one of the substances
12 based at least in part on a time delay between the first and second electromagnetic signals.
- 1 2. The system of claim 1 wherein the first and second conductive elements are positioned
2 substantially parallel to each other and substantially perpendicular to the dielectric mismatch
3 boundary.
- 1 3. The system of claim 1 wherein the first electromagnetic signal exhibits an ultra-wideband
2 frequency.
- 1 4. The system of claim 1 wherein the dielectric mismatch boundary corresponds to a
2 transitional region between a gaseous substance and a liquid substance.
- 1 5. The system of claim 1 wherein the dielectric mismatch boundary corresponds to a
2 transitional region between at least two of a vacuum, a gaseous substance, a liquid substance, a
3 semi-solid substance, and a solid substance.

- 1 6. The system of claim 1 further comprising a transmitter for forming the first
2 electromagnetic signal.
- 1 7. The system of claim 1 further comprising a receiver for detecting the time delay between
2 the first and second electromagnetic signals.
- 1 8. The system of claim 7 wherein the receiver includes an equivalent time sampling circuit.
- 1 9. The system of claim 1 wherein the first and second conductive elements form a parallel
2 conductor transmission line structure.
- 1 10. The system of claim 1 wherein the first and second conductive elements are flexible.
- 1 11. The system of claim 1 wherein the first and second conductive elements exhibit
2 quadrilateral cross-sections.
- 1 12. The system of claim 1 wherein the first and second conductive elements exhibit
2 substantially identical cross-sections.
- 1 13. The system of claim 1 wherein an amplitude of the second electromagnetic signal is
2 substantially independent of dielectric properties associated with the substances forming the
3 dielectric mismatch boundary.
- 1 14. The system of claim 1 wherein the coupler exhibits a length corresponding to at least
2 one-quarter of a propagation velocity pulse length of the first electromagnetic signal.
- 1 15. The system of claim 1 further comprising:
2 a float for positioning the coupler at the dielectric mismatch boundary.

- 1 16. The system of claim 15 wherein the float includes a buoyant component and a weighted
2 component.
- 1 17. The system of claim 1 wherein the level corresponds to a volume of fluid in an above-
2 ground storage tank.
- 1 18. The system of claim 1 wherein the level corresponds to a volume of fluid in a below-
2 ground storage tank.
- 1 19. The system of claim 1 wherein the processor communicates the substance level to a
2 digital data processing device during a communication session.
- 1 20. A method of determining a level of a substance, the method comprising:
2 transmitting a first electromagnetic signal on a first conductive element, the first
3 conductive element being in proximity to a plurality of substances;
4 providing a coupler positioned at a dielectric mismatch boundary between the substances,
5 the coupler causing a change in a capacitance of the first conductive element upon the first
6 electromagnetic signal traversing a part of the first conductive element substantially adjacent to
7 the coupler;
8 receiving a second electromagnetic signal based on the first electromagnetic signal at a
9 second conductive element and in response the change in capacitance of the first conductive
10 element caused by the coupler; and
11 determining a level of at least one of the substances based at least in part on a time delay
12 between the first and second electromagnetic signals.
- 1 21. The method of claim 20 wherein the first and second conductive elements are flexible.

1 22. The method of claim 20 wherein the first and second conductive elements are positioned
2 substantially parallel to each other and substantially perpendicular to the dielectric mismatch
3 boundary.

1 23. The method of claim 20 wherein an amplitude of the second electromagnetic signal is
2 independent of dielectric properties associated with the substances forming the dielectric
3 mismatch boundary.

1 24. The method of claim 20 further comprising:
2 providing a float for positioning the coupler relative to the dielectric mismatch boundary.